

Combined Fractures of the Scaphoid and Distal Radius: Evaluation of Early Surgical Fixation (21 Patients with 22 Wrists)

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Abstract

Introduction The purpose of this retrospective study, is to evaluate the clinical and functional results of early surgical fixation of the ipsilateral distal radius and scaphoid fractures in 22 of 21 patients.

Patients and Methods Overall, 22 combined ipsilateral scaphoid, and distal radius fracture treatments between 2002 and 2015 were evaluated. The mean age was 34.9 (range: 19–82) years. One patient had bilateral injuries. In 17 patients the injury was due to a fall from a height, and in 4 patients due to a motorcycle accident. According to the AO classification, there were 2 type B and 20 type C fractures of the distal radius. The volar locking plate fixation technique was applied in 14 wrists, screw fixation technique in 1, external fixation combined with Kirschner wires (K-wire) stabilization technique was used in 3 wrists, and only K-wire pinning technique was used in 4 wrists. All scaphoid fractures were type B (21 type B2, 1 type B1) according to the Herbert–Fischer classification. K-wire fixation was applied in 2 and cannulated screw fixation was performed in 20 fractures. Clinical evaluation was performed with measuring the pinch power, grip power, and range of motions. Functional evaluation was performed using patient-rated wrist evaluation score (PRWE).

Results The average follow-up period was 25 (range: 12–97) months. All radius and scaphoid fractures healed. The mean active wrist motions were found to be 45 degrees of flexion, 48.5 degrees of extension, 20 degrees of radial deviation, and 43 degrees ulnar deviation. Mean grip/pinch strengths were 31/8.5 kg. Mean PRWE score was 5.5 (range: 0–8.5). All patients returned to preoperative activity level and can do preinjury jobs.

Conclusion Combined ipsilateral fractures of distal radius and scaphoid are complex and rare injuries due to high energy traumas. Stable early primary fracture fixation in these injuries can be expected with good functional results.

Level of Evidence Level IV.

Keywords

- fracture
- radius
- scaphoid
- combined
- ipsilateral
- volar locking plate

Combined ipsilateral fractures of distal radius and scaphoid are rare injuries.¹ There is no consensus regarding the mechanism of injury, optimal treatment strategy, and treatment outcomes. These fractures have been reported in approximately 0.7 to 4% of all upper extremity fractures.^{2–4}

The number of combined fractures undergoing surgery was considerably small in previously published series (► **Table 1**).^{1,5–9} The number of studies investigating the outcomes of surgical treatment, in which evaluation criteria are based on objective factors, is relatively small. The effects

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Table 1 Reports on the outcome for combined scaphoid and radius fracture

Author (year)	Cases (Fx)	Operative/ conservative	Mean age	Follow-up	Fracture type			Treatment		Activities of daily living	Results	Complications
					Distal radius	Scaphoid	Distal radius	Scaphoid				
Vukov et al (1988) ¹⁸	26	0/26	? (16–61)	–	Colles fx with ulnar styloid fx: 10 Isolated Colles fx: 7 Fx of distal radius entering joint: 3 Radial styloid fx: 3 Barton's fx: 2 Distal radius epiphysiolysis: 1	Undisplaced	Cast: 26	Conservative	–	Satisfactory result: 26 Full movement: 11 Slightly limited motion: 15		
Tountas and Waddel (1987) ³	7	3/4	30 (16–59)	20 mo (12–52)	Frykmann classification Type VIII: 3 Type VII: 1 Type III: 1 Type VI: 1 Type V: 1	Waist: 5 Distal third: 2 Significantly displaced: 1 Undisplaced: 6	Cast: 4 EF: 3 (open fractures)	Screw: 2 Conservative: 5	–	Modified Gartland–Werley Satisfactory result: 7 Mild postoperative arthrosis: 2 Advanced postoperative arthrosis: 1	Proximal pole avascular necrosis: 1	
Hove (1994) ¹	12	1/11	35 (11–73)	–	Older et al (1965) classification Colles older type4: 2 Colles older type1: 2 Radial styloid fx: 6 Salter Harris tip II: 1 Greenstick: 1	Herbert and Fisher (1984) A2: 8 B3: 5 Distal 1/3: 1	Cast: 11 K-wire: 1	Conservative	–	Satisfactory result: 11 Radiocarpal arthrosis: 1	Carpal tunnel syndrome: 2	
Oskam et al (1996) ²¹	23	3/20	39 (18–74)	7 y (1–13)	Extra-articular fx: 15 Intra-articular fx: 6 Chauffeur's fx: 1 Barton fx: 1	Middle third: 7 Waist: 14 Distal third: 2	Cast: 18 EF: 2 Screw: 1	Conservative	–	Good: 18 Fair: 2 Poor: 1	Closed re-reduction: 2 and K-wire	
	8	7/1	55 (31–90)	4.4 y (1–11.6)	AO classification A2: 1	Waist: 8	Cast: 1 K-wire + cast: 1	K-wire: 3	–	Oskam evaluation system	Superficial radial nerve problem: 1	

Table 1 (Continued)

Author (year)	Cases (Fx)	Operative/conservative	Mean age	Follow-up	Fracture type		Treatment		Activities of daily living	Results	Complications
					Distal radius	Scaphoid	Distal radius	Scaphoid			
Chang et al (2000) ⁴					B3: 4 C1: 2 C2: 1		EF + K-wire: 3 EF: 1 Buttress plate: 2	Cannulated screw: 2 Cast: 3		Good: 5 Fair: 3 The distal radius fractures in two patient healed in the grade 2 deformity position according to Sarmiento et al's criteria	
Slade JF III et al (2005) ⁶	7	7/0	30 (18–58)	24 mo (12–42)	Radial styloid fx: 2 Volar shearing fx: 1 Colles fx: 2 Intra-articular fx: 2	Waist: 6 Proximal pole: 1 Displaced 1 mm or greater: 7	VLP with allograft: 7 (Arthroscopic)	Cannulated screw: 7 (Arthroscopic)	–	Flex/Ext/RD/UD: 50/65/15/26 Grip/pinch: 90/110 lb	EPL rupture
Rutgers et al (2008) ⁸	10	9/1	27 (19–41)	40 mo (12–90)	AO classification B1: 1 C: 8 (C3: 6, C1: 2) A: 1	Waist: 7 Proximal pole: 2 Distal pole: 1	Cast: 1 Cannulated screw: 1 EF: 1 Dorsal plate: 5 VLP: 2	Cannulated screw: 9 Cast: 1	–	Flex/Ext/RD/UD: 57/71/12/31	Loosening of a screw securing: 1 Carpal syndrome: 3 Proximal pole avascular necrosis: 1
Komura et al (2012) ²	8	8/0	42 (19–70)	–	AO classification B: 6 (B1: 2, B2: 3, B3: 1) C3: 2	Waist: 2 Proximal pole: 3 Distal pole: 1 Dorsal ridge: 2	Cast: 4 Cannulated screw: 1 EF + K-wire: 1 VLP: 2	Cannulated screw: 3 Cast: 5	–	–	–
Present study	22	22/0	34.9 (19–50)	25 mo (12–96)	AO classification B1: 2 C: 20 (C1: 3, C2: 5, C3: 12)	Herbert And Fischer B2: 21 B1: 1	Screw: 1 EF + K-wire: 3 K-wire: 4 VLP: 14	Cannulated screw: 20 K-wire: 2	PRWE: 5.5 (0–8.5)	Flex/Ext/RD/UD: 45/48/20/43 Grip/pinch: 31/8.5 n = 20	Ulnar nerve entrapment (case 1)

Abbreviations: EF, external fixator; Flex/Ext/RD/UD, flexion/extension/radial deviation/ulnar deviation; K-wire, Kirschner wire; PRWE, patient-rated wrist evaluation score; VLP, volar locking plate.

of this high-energy trauma on daily life have not been addressed in previous reports.^{1,4,6,8}

The purpose of this retrospective study is to evaluate clinical and functional outcomes of primary surgical treatment in 22 of 21 patients with ipsilateral distal radius and scaphoid fractures.

Patients and Methods

Of 882 distal radius and 112 scaphoid fractures of patients undergoing surgery between 2002 and 2015, 22 fractures of 21 patients with combined fractures of ipsilateral scaphoid and radius were evaluated retrospectively. The study was approved by the local ethics committee of our hospital. There were 17 male and 4 female patients with a mean age of 34.9 (range: 19–82) years. One patient had bilateral injuries. The dominant side was injured in 14 patients.

In 17 patients the injury was due to a fall from a height, and in 4 patients due to a motorcycle accident. The mean time from injury to surgery was 1.2 (range: 0–6 days) days. The concomitant injuries included as ipsilateral ulnar styloid fractures in 10 patients, contralateral distal radius fractures in 5 patients, an ipsilateral ulnar fracture in 1 patient, and ipsilateral dislocation of the shoulder and femoral fracture in 1 patient. Ulnar nerve injury was detected in one type 1 open fracture according to the Gustillo–Anderson classification.¹⁰

Three types of the job were represented: nonmanual work in 6 cases, manual labor in 11 cases, and heavy manual labor in 4 cases. Heavy manual labor was defined as requiring forceful activities with repetitive movements, especially with the arms overhead (plasterer, painter, mason, hairdresser, road hauler, etc.)

Based on the AO classification of distal radius fractures, 2 fractures were type B1 and 20 were type C (3 C1, 5 C2, and 12 C3).⁹ Overall, 14 fractures were fixed with volar locking

plates, 4 with K-wires, 1 with screw, and 3 with external fixators and K-wires (►Figs. 1 and 2). If the stability and position of the fracture were sufficient after closed reduction, then K-wires or external fixators were used. For four fractures, dorsal plating was performed in addition to fixation with the volar locking plate. The indication for combined dorsal and volar plate fixation was a fracture of the distal part of the radius with complex comminution of the articular surface and metaphysis for which a single dorsal or volar plate would not be sufficient. Because of the metaphyseal bone defect, autogenous bone grafting was performed in four fractures.

According to the Herbert–Fischer classification, scaphoid fractures were classified as B2 in 21 fractures, and B1 in 1 fracture.¹⁰ The type of implant used in the surgery was determined by the manufacturing dates of implants. K-wires were used as the fixation material in 2 patients and cannulated screws in 20 patients (Acutrak screws in 12 fractures [Acumed, Beaverton, OR] and Herbert screws in 6 fractures [Zimmer, Warsaw, IN]). Percutaneous fixation was performed in 15 fractures and open fixation in 5 fractures.

In all patients, the scaphoid fractures were initially fixed before distal radius fractures.

All patients were encouraged to begin finger exercises on the first day of surgery. Wrist exercises were initiated at the third postoperative week in patients treated with a volar locking plate and between postoperative sixth and ninth weeks in patients treated with a fixator. The mean duration time of immobilization was 4.5 weeks (range: 3–9 weeks). On the final follow-up, patients underwent radiographic assessment in three planes (anteroposterior, lateral and oblique or scaphoid graphy). Bone bridgings on the radial, ulnar, and dorsal cortex were considered when diagnosing radiological fracture union. Union of scaphoid was evaluated based on the presence of cross-trabeculation.¹¹



Fig. 1 Preoperative X-ray with combined fractures.



Fig. 2 Postoperative X-ray; internal fixation with a volar locking plate and scaphoid fractures.

Clinical evaluation was performed with pinch power (Baseline hydraulic pinch gauge, Irvington, NY), grip power (Jamar hydraulic hand dynamometer; Sammons Preston Patterson Medical Products, Inc., Bolingbrook, IL), and range of motions.

Functional evaluation was performed using patient-rated wrist evaluation (PRWE) questionnaire.¹² PRWE form is an established outcome questionnaire designed to measure wrist pain and disabilities in activities of daily living. The PRWE program calculates two subscale scores (pain and function) as well as a total score (0–100). The total PRWE score rates pain and disability equally.

The range of motion, pinch, and grip strengths of both wrists in 13 patients without injury on the opposite side were compared statistically with SPSS for Windows (release 14.0; SPSS, Chicago, IL). Data comparison was performed with the *t*-test. Statistical significance is considered to be p value < 0.05.

Results

The mean duration of follow-up was 25 (range: 12–97) months. All radius and scaphoid fractures healed.

The clinical and functional evaluation of 22 fractures of 21 patients revealed a mean flexion of 45 (range: 30–60) degrees, an extension of 48.5 (range: 40–70) degrees, radial deviation of 20 (range: 10–30) degrees, and ulnar deviation of 43 (range: 20–60) degrees. The mean grip strength was 31 (range: 22–48) kg, pinch strength was 8.5 (range: 7–12) kg, and PRWE was 5.5 (range: 0–8.5).

In patients undergoing fixation with a volar locking plate and cannulated screw, the mean flexion was 49 (35–60)

degrees, the extension was 51 (range: 40–60) degrees, the radial deviation was 22 (range: 12–35) degrees, and the ulnar deviation was 37.5 (range: 20–55) degrees. In this group, the mean grip strength was 30.9 (range: 22–39) kg, pinch strength was 8.1 (range: 5–11) kg, and PRWE was 5 (range: 0–20) (→Fig. 3).

The comparison of both wrists in patients with uninjured wrists ($n = 15$) revealed statistically significant differences in all ranges of motion, grip and pinch strengths ($p < 0.01$). The mean range of motion (relative to the contralateral wrist) was 83% for palmar flexion, 88% for extension, 83% for radial deviation, and 85% for ulnar deviation angles.

All radius and scaphoid fractures united. One patient with an open fracture underwent an external neurolysis of the ulnar nerve due to hypoesthesia in the distal part of the injury level at first month after the injury. At 3 months after neurolysis, sensory and motor function of the ulnar nerve was restored.

Discussion

The incidence of combined distal radius and scaphoid fractures has been reported to a range of 0.7% to 4%.^{2,3,13} The incidence, and gender distribution of combined fractures are parallel to those of distal radius fractures.¹ But ipsilateral radius and scaphoid fractures are rare injuries, no large series in the literature. In our series, combined fractures accounted for 4.2% of all operated distal radius fractures. Of 22 patients, 17 were male with a mean age of 36.9 years.

In the literature, particularly initial studies have reported satisfactory results with plaster immobilization for the treatment of combined fractures.^{3,7} However, subjective

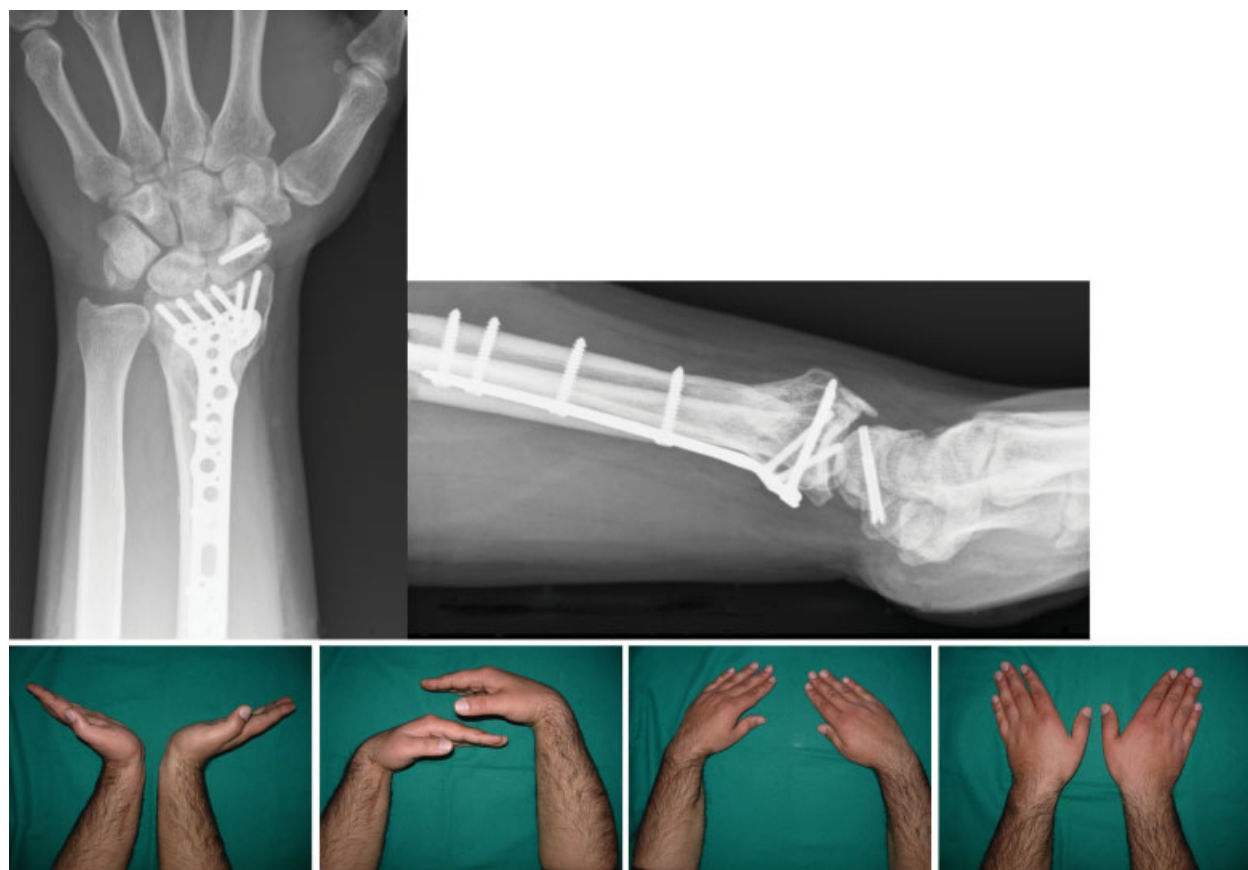


Fig. 3 Clinical and radiographic results at 20 months.

evaluation criteria were used to assess clinical outcomes in these studies. In studies reporting surgical outcomes, the results were mostly reported as ranges of motions. Extension/flexion of 50 to 75 degrees were reported after a mean follow-up of 24 months by Slade et al in 7 patients.⁶ In a series of 10 patients by Rutgers et al, the mean range of flexion/extension after a mean follow-up of 40 months was reported to be 57° -71°.⁸ Considering the range of motion obtained in these series, the mean flexion/extension was 45/48.5 degrees. Limited range of motions in our patients compared with the literature could be explained by the high number of “C” type distal radius fractures. Mean range of motions in our patients directly correlates with the published data of other “C” type of injuries.¹⁴⁻¹⁶

Overall, 22 fractures with surgical treatment seem to be the largest series reported in the literature. Clinical and functional results are mostly reported with a range of motions in the literature. In our study, we also evaluated pinch power, grasp power, and PRWE scores with a range of motions.

It is of great importance to what extent these injuries restrict an individual's daily life. The mean PRWE score in our patient group was 5. The results indicate that wrist exercises soon after early rigid fixation have an important role in the treatment of these kind of injuries. Combined fractures mostly occur in active young adults who desire early return

to work with the unimpaired quality of bone despite high energy. Therefore, we recommend early surgical stabilization in fractures for early movement and return to work. However, the comparison of the range of motion, and pinch and grip strengths of the injured wrist versus the contralateral side revealed a statistically significant difference in 15 patients with no injury in other extremities. Thus, when properly treated, combined fractures resulting from high energy traumas do not negatively impact the daily lives of patients according to our PRWE scores. However, it should be remembered that the range of motion of the injured extremity is reduced compared with that of the contralateral extremity.

In studies evaluating surgical treatment of combined fractures, the low incidence of injury makes it difficult to obtain large series of patients. Therefore, previous studies have reported conflicting views on the order of fracture fixation and fixation materials (–Table 1). Some authors begin fixation with the radius while others begin fixation with the scaphoid.^{3,7} Slade et al reported that first, percutaneous reduction of the scaphoid fracture was performed and then provisional stabilization was achieved with a guide-wire.⁶ After the fixation of the radius fracture, osteosynthesis was performed using a cannulated screw along the scaphoid.⁸ In our opinion, before radius fracture fixation, screw fixation was the first method of choice to stabilize for the

scaphoid fracture in all patients. We believe that the manipulations for reduction of the distal radius might replace the scaphoid positions. Also, stabilization of radial side of distal radius fracture might prevent the fluoroscopic control of the scaphoid position and fixation. We fixed all scaphoid fractures using screws, and K-wires and most of the scaphoid fractures were unstable and nondisplaced fractures by Herbert-Fischer classification.

In surgical fixation of radius fractures, the use of external fixator, K-wires, screws, and conventional plates has been used before.^{6,7,17,18} In our study, osteosynthesis was performed using volar locking plates in 14 of the radius fractures, screws in 1 fracture, K-wires and external fixators in 3 fractures, and K-wires in 4 fractures. The use of locking plate system allowing early motion in wrist fractures has been increased since the beginning of the 2000s.¹⁹ Despite reports on the use of locking plate and cannulated screw fixation in patients with combined fractures, the number of patients is limited. Komura et al reported the use of locking plates in 2 of 8 fractures and Rutgers et al in 2 of 10 fractures.^{2,8} In both studies, the number of the volar locking plates used were a few, with the lack of detailed evaluation on clinical outcomes of patients. Ozkan et al reported flexion/extension of 42/45 degrees with cannulated screws and locking plate fixation in one patient with a bilateral injury.²⁰ Slade et al reported flexion/extension of 50/65 degrees with locking plate and cannulated screws in seven patients with combined fractures.⁶ In our series, locking plates were used for distal radius fractures (12 fractures C3, 5 fractures C2) in 14 patients. The mean flexion/extension was 49 (range: 30–60 degrees)/51 (range: 30–65 degrees). We consider that one patient with bilateral injury undergoing locking plate fixation affected clinical outcomes.

The limitations of this study were the retrospective design, different surgical techniques, and the difference in the fixation materials. Due to the low incidence of injury, it is difficult to obtain large series and to plan prospective designs. But the present study reports one of the largest series in the literature of surgery of ipsilateral combined distal radius and scaphoid fractures.

Conclusion

Combined fractures of the ipsilateral distal radius and scaphoid are complex and rare injuries that are usually accompanied by additional injuries, resulting from high energy traumas. Early operative stabilization especially volar locking plates and cannulated compression screws, which have been used increasingly since the 2000s, are of benefit ineffective treatment.

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Conflict of Interest

None.

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